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Jet Propulsion Laboratory – California Institute of Technology

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Relevant Experience

- Technologist III at Jet Propulsion Laboratory (JPL), supporting flight and R&D projects through software and electronic ground support equipment (EGSE) development/operation
- Design/development/operation of test facilities, software, electronic ground support equipment (EGSE) for flight hardware verification & validation (V&V), product quality verification (PQV), integration & testing (I&T)
- Design/development/operation of ground-based research and development (R&D) laboratory systems/facilities
- Lead software engineer for flight hardware component verification/validation through EGSE thermal metrology, including the SHERLOC laser, laser power supply, and SHERLOC EM/FM models.
- Facility manager of the JPL 169-123 environmental testing facility, used for flight hardware and subsystems, including qualification, life testing, and verification/validation
- Software developer and facility management support for the JPL 169-108 and 168-111 environmental test facility, used for verification/validation/qualification of the SHERLOC Mars 2020 instrument and other flight mission hardware
- Extensive experience with wide variety of systems used in R&D and flight V&V, PQV, I&T: ultrahigh vacuums (UHV), thermal vacuums (TVac), environmental chambers, mass spectrometers, digital/analog circuit design, cryogenic systems, cryogenic sample preparation/handling, lasers, charged particle optics, facility and hardware metrology
- Extensive experience with data acquisition and instrument control systems, data processing/reduction, remote control/operation of test facilities, autonomous test facilities with multiple hardware-level and software-level redundancies
- Development of software for autonomous operation of test facilities, including ETL-certified unattended operation of flight hardware V&V
- Experimental physics/chemistry background

Education

- Ph.D., Physics, June 2010, University of Manitoba, Winnipeg, MB, Canada
Thesis: Electron Scattering from Laser-Excited ^{138}Ba and ^{174}Yb -
<http://mspace.lib.umanitoba.ca/handle/1993/3965>
- B.Sc.(honors), Physics, June 2002, University of Manitoba, Winnipeg, MB, Canada

Professional Experience

Nov 2015 – present **Technologist**

Jet Propulsion Laboratory
Pasadena, CA

- Lead software engineer for the Mars 2020 SHERLOC instrument environmental testing facility

- Verification/validation of flight hardware components through thermal metrology ground support equipment (GSE) design/operation
- Development of software for SHERLOC optical brassboard
- Development of software/electronics for verification/validation of the SHERLOC instrument via environmental vacuum chamber and associated electronic GSE software to qualify the full SHERLOC instrument prior to its launch
- Co-investigator for survivability study of bacterial spores subjected to ultraviolet irradiation relevant to icy world conditions.
- Software and electronics support for the Laboratory Studies group of the Science division, the Planetary Surface Instruments group of the Instruments division, electronic ground support equipment tasks, supporting development of instruments including Mars 2020 MOXIE instrument mission, InSight seismometer, and Spacecraft Atmospheric Monitor.
- Directed intern research programs in the Planetary Surface Instruments and Planetary Ices groups.

Nov 2014 – Oct. 2015 Postdoctoral Scholar (Caltech) Jet Propulsion Laboratory

Nov 2012 – Nov 2014 Postdoctoral Scholar (NPP) Jet Propulsion Laboratory

- Designed, constructed, and tested research apparatus for studying the production of metastable oxygen species by electron-impact dissociative excitation of oxygen-containing molecules;
- Developed experiments for temperature- and wavelength-dependence studies of photodesorption from cryogenic ice matrices; and
- Directed undergraduate research programs in the Planetary Ices research groups.

Sep 2011 – Jan 2012 Sessional Instructor University of Windsor Windsor, ON, Canada

- Worked as lecturer for undergraduate physics course of roughly 250 students;
- Prepared lecture notes, course assignments, test material; and
- Directed graduate/undergraduate teaching assistants for roles in workshops and laboratory studies.

Sep 2010 – Aug 2012 Postdoctoral Fellow University of Windsor

- Studied electron-impact dissociative excitation of biomolecules through electron-impact-induced vacuum-ultraviolet (VUV) emission spectroscopy;
- Designed and built experimental hardware to produce a beam of biomolecules for electron collision spectroscopy studies; and
- Studied the production of metastable oxygen species by electron-impact dissociative excitation of oxygen-containing molecules.

June 2010 – Aug 2010 Postdoctoral Scholar University of Manitoba Winnipeg, MB, Canada

- Studied electron collision processes from laser-excited metal vapor atoms;
- Developed data acquisition systems and laser frequency stabilization electronics; and
- Directed undergraduate research.

Nov 2008 – Dec 2008 Laboratory Instructor/Technician University of Manitoba

- J.D. Hein, S. Kidwai, P.W. Zetner, C.J. Bostock, D.V. Fursa, I. Bray, L. Sharma, R. Srivastava, and A. Stauffer, Differential cross sections for electron-impact excitation of laser-excited ^{174}Yb (...6s6p $^3\text{P}_1$), *J. Phys. B: At. Mol. Opt. Phys.*, **44**, 015202 (2011).
- J.D. Hein, C. Ududec, D.K. Sasaki, and P.W. Zetner, Integral cross sections for electron-impact ionization-excitation of laser-excited barium, *J. Phys. B: At. Mol. Opt. Phys.*, **43**, 0185206 (2010).

Published Conference Proceedings

- J D Hein, S Kidwai, and P W Zetner, Electron scattering from excited-state ytterbium. *J. Phys.: Conf. Ser.*, 194(4):042035, 2009.

Conference Contributions

- J D Hein, P V Johnson, I Kanik, and C P Malone, Metastable Oxygen Production by Electron-Impact of O₂, N₂O, and CO₂, 45th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS), June 2-6, 2014, Madison, Wisconsin, USA.
- J W McConkey, C Tiessen, J D Hein, J Trocchi, and W Kedzierski, Dissociative Excitation of Thymine by Electron Impact, 45th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS), June 2-6, 2014, Madison, Wisconsin, USA.
- C Tiessen, J W McConkey, W Kedzierski, J D Hein, and J A Trocchi. Dissociative Excitation of Thymine by Electron Impact, Canadian Association of Physicists (CAP) Congress, June 16-20, 2014, Sudbury, ON, Canada.
- J D Hein, C P Malone, I Kanik, P V Johnson, Metastable Oxygen Production by Electron-Impact of Oxygen, 46th Fall Meeting of the American Geophysical Union (AGU), December 9-13, 2013, San Francisco, California, USA,.
- C P Malone, P V Johnson, J D Hein, B Grisanti, and M A Khakoo, Near Threshold Excitation of Molecular Nitrogen: Benchmarking Cross Sections for Upper Atmospheres, 46th Fall Meeting of the American Geophysical Union (AGU), December 9-13, 2013, San Francisco, California, USA.
- W Kedzierski, J D Hein, C Tiessen, D Lukic, J Trocchi, T Mlinaric, and J W McConkey. O(1D) Production in Electron-Carbon Dioxide Collisions, 44th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 3-7, 2013, Quebec City, Quebec, Canada.
- J D Hein, H Al-Khazraji, C Tiessen, D Lukic, J Trocchi, and J W McConkey, VUV Study of Electron-Pyrimidine Dissociative Excitation, 44th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 3-7, 2013, Quebec City, Quebec, Canada.
- C P Malone, P V Johnson, J D Hein, B Grisanti, and M A Khakoo, Near-Threshold Electron Impact Excitation of Molecular Nitrogen, 44th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 3-7, 2013, Quebec City, Quebec, Canada.
- C P Malone, P V Johnson, X Liu, B Ajdari, J D Hein, S Muleady, I Kanik, and M A Khakoo, Direct electron impact excitation of Rydberg-valence states of molecular nitrogen, 45th annual Fall

Meeting of the American Geophysical Union (AGU), December 3-7, 2012, San Francisco, CA, USA.

- J W McConkey, W Kedzierski, and J D Hein, Progress report on O(1D) production from oxygen containing molecules. 43rd Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS), June 4-8, 2012, Orange County, CA.
- S J Brotton, J D Hein, and J W McConkey, VUV study of dissociative excitation of S-containing molecules following electron impact. 27th International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC), July 27-August 2, 2011, Belfast, Northern Ireland, UK.
- W Kedzierski, E Blejdea, A DiCarlo, J D Hein, and J W McConkey, O(1D) production following electron impact on oxygen-containing molecules. 27th International Conference on Photonic, Electronic and Atomic Collisions, July 27-August 2, 2011, Belfast, Northern Ireland, UK.
- J W McConkey, W Kedzierski, E Blejdea, A DiCarlo, and J D Hein, O(1D) production following electron impact by oxygen-containing molecules. 42nd Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS), June 13-17, 2011, Atlanta, GA, USA.
- J D Hein, S Kidwai, and P W Zetner, Electron scattering from excited-state ytterbium, XXVI International Conference on Photonic, Electronic and Atomic Collisions, July 22-28, 2009, Kalamazoo, MI, USA.
- J D Hein and P W Zetner, Elastic electron scattering from the 6p and 5d levels of Ba. 38th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 5-9, 2007, Calgary, AB, Canada.
- J D Hein and P W Zetner, Electron impact induced excited-state to excited-state transitions in Yb. 38th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 5-9, 2007, Calgary, AB, Canada.
- P W Zetner and J D Hein. Electron scattering from laser-excited Ba and Yb atoms. 38th Meeting of the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society (APS) Joint with the Division of Atomic, Molecular and Optical Physics Canada (DAMOPEC) of the Canadian Association of Physicists (CAP), June 5-9, 2007, Calgary, AB, Canada.
- J D Hein and P W Zetner, Elastic electron scattering from excited P states of Ba and Yb atoms. 24th International Conference on Photonic, Electronic and Atomic Collisions, July 23-29, 2003, Stockholm, Sweden.
- P W Zetner and J D Hein, Electron impact ionization-excitation of laser excited barium, 12th International Symposium Polarization and Correlation in Electronic and Atomic Collisions, July 30 – August 2, 2003, Koenigstein, Germany.
- J D Hein and P W Zetner. Electron impact excited photoemission from laser excited atoms, Canadian Association of Physicists (CAP) Congress, June 8-11, 2003, Quebec, Canada.

Notable Software/Electronics Development

- Multithreaded, OOP-based data acquisition and instrument control framework developed in LabVIEW, implemented in a variety of ground support equipment systems for the Mars 2020 SHERLOC mission.

- Laser frequency stabilization system relying on active feedback of resonant atom fluorescence utilizing cooperative communication between networked microcontrollers and digital/analog circuitry, programmed using C and assembly language;
- Data acquisition and measurement control featuring interactive GUI and instrument operational scripting of networked microcontrollers and digital/analog circuitry, using C# and PBASIC; and
- Extensible multi-configuration software for operation, instrument status logging, data acquisition, and data reduction of experimental systems utilizing mass spectrometers, electron energy loss spectrometers, metastable particle TOF detectors, VUV fluorescence spectrometers, and cryostat stage configuration manipulation, using C# and LabVIEW.

Programming Language Proficiency

- C, C++, C#, Objective-C, Assembly Language
- BASIC, QuickBasic, Visual Basic, PBASIC
- Fortran, MATLAB, Mathematica, Maple, Python, Java, LabVIEW OOP
- SIMION, SketchUp, SolidWorks